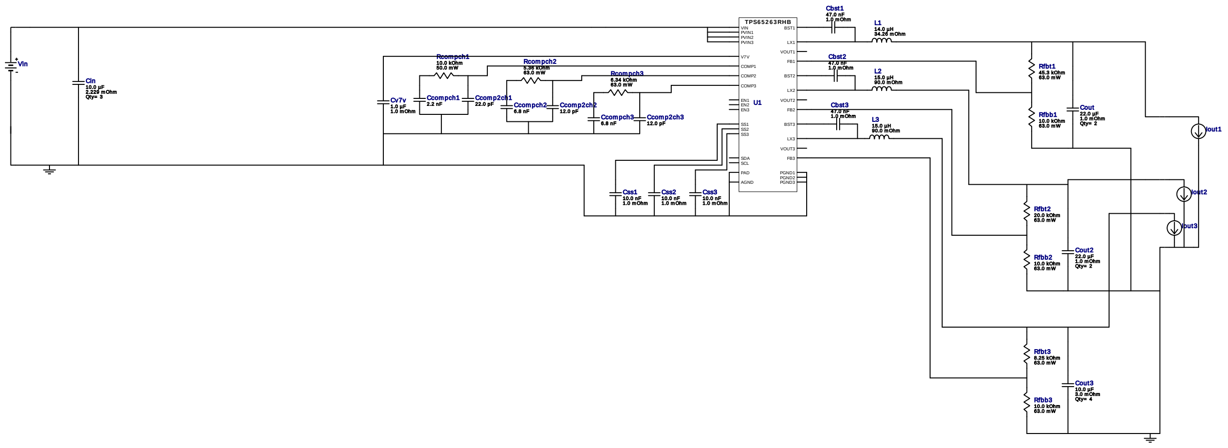
TEXAS INSTRUMENTS

VinMin = 4.5V
VinMax = 18.0V
Vout = 1.5V
Iout = 2.0A

Device = TPS65263RHBR
Topology = Buck
Created = 2025-03-02 17:21:30.018
BOM Cost = $4.92
BOM Count = 37
Total Pd = 0.4W

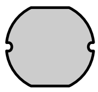
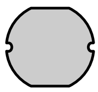
WEBENCH ® Design Report

Design : 19 TPS65263RHBR
TPS65263RHBR 4.5V-18V to 1.50V @ 2A



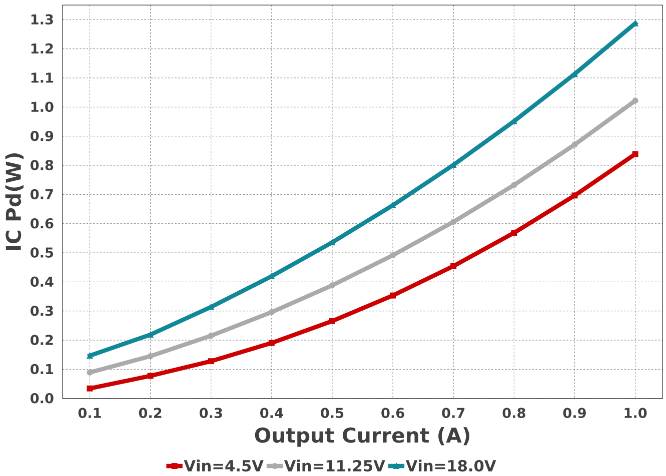
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst1	MuRata	GRM155R71A473KA01D Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cbst2	MuRata	GRM155R71A473KA01D Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cbst3	MuRata	GRM155R71A473KA01D Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp2ch1	Samsung Electro-Mechanics	CL21C220JBANNNC Series= C0G/NP0	Cap= 22.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp2ch2	Yageo	CC0805JRNPO9BN120 Series= C0G/NP0	Cap= 12.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp2ch3	Yageo	CC0805JRNPO9BN120 Series= C0G/NP0	Cap= 12.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccompch1	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
Ccompch2	TDK	C2012C0G1H682J060AA Series= C0G/NP0	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
Ccompch3	TDK	C2012C0G1H682J060AA Series= C0G/NP0	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
Cin	TDK	C3216X7R1V106K160AC Series= X7R	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	3	$0.18	1206_180 11 mm²

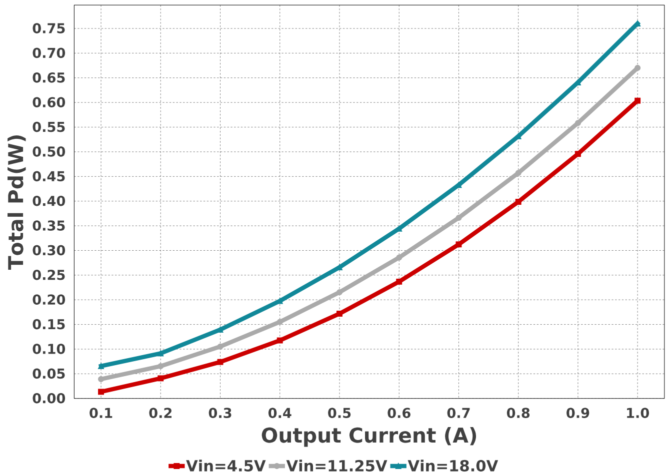
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cout	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	2	$0.04	0603 5 mm^2
Cout2	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	2	$0.04	0603 5 mm^2
Cout3	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	4	$0.03	0805 7 mm^2
Css1	MuRata	GRM155R71C103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Css2	MuRata	GRM155R71C103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Css3	MuRata	GRM155R71C103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cv7v	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
L1	Wurth Elektronik	78433391400	L= 14.0 µH 34.26 mOhm	1	$2.14	WE-CHSA_1011 159 mm^2
L2	NIC Components	NPI75C150MTRF	L= 15.0 µH 90.0 mOhm	1	$0.11	 IND_NPI75C 94 mm^2
L3	NIC Components	NPI75C150MTRF	L= 15.0 µH 90.0 mOhm	1	$0.11	 IND_NPI75C 94 mm^2
Rcompch1	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rcompch2	Vishay-Dale	CRCW04025K36FKED Series= CRCW..e3	Res= 5.36 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rcompch3	Vishay-Dale	CRCW04026K34FKED Series= CRCW..e3	Res= 6.34 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb1	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb3	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt1	Vishay-Dale	CRCW040245K3FKED Series= CRCW..e3	Res= 45.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt2	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt3	Vishay-Dale	CRCW04028K25FKED Series= CRCW..e3	Res= 8.25 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS65263RHBR	Switcher	1	$1.45	 RHB0032E 49 mm²

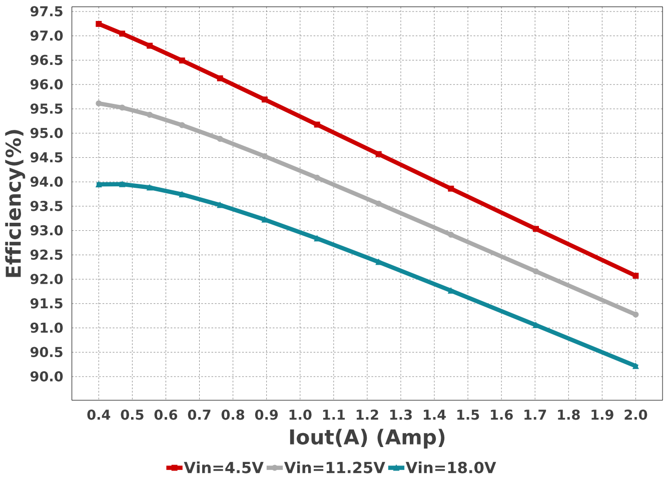
IC Pd



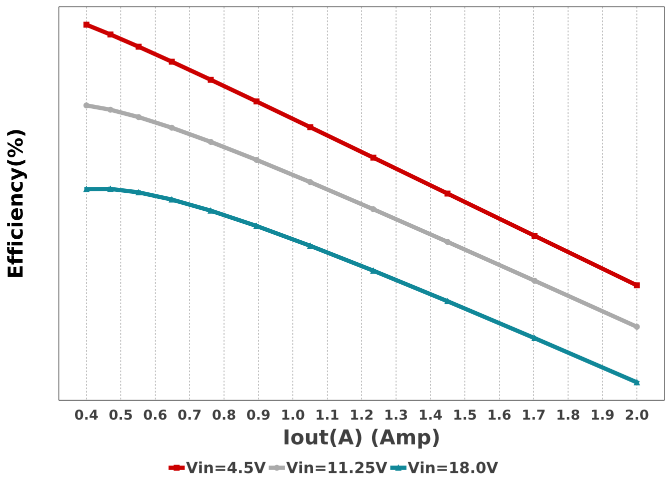
Total Pd



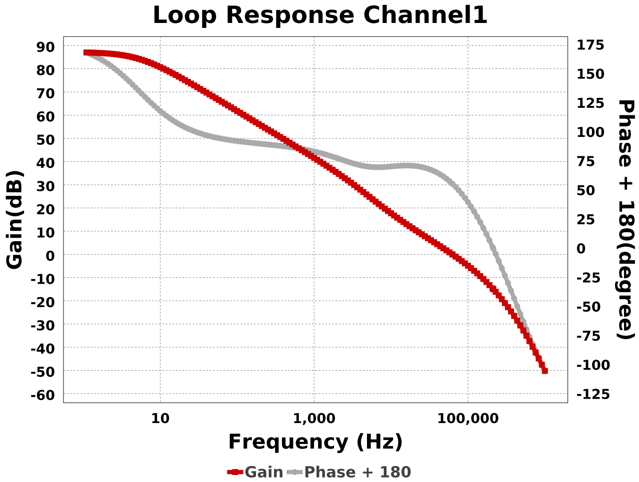
Efficiency



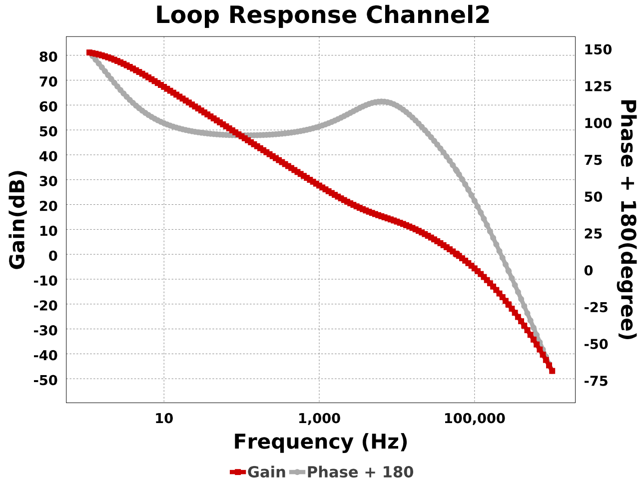
Efficiency(Log chart)

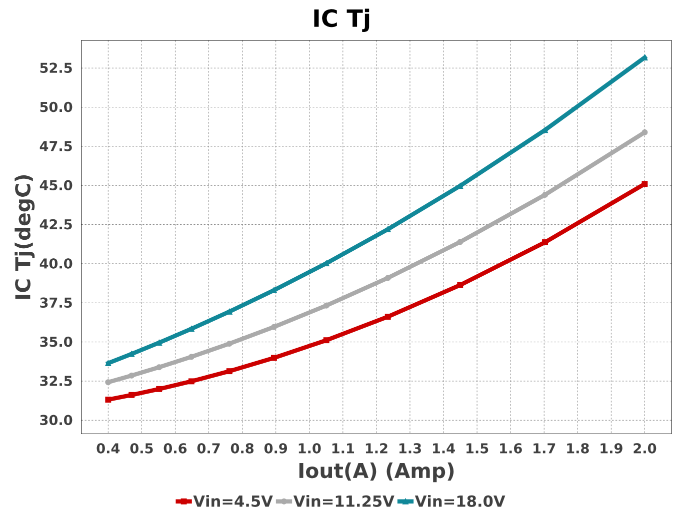


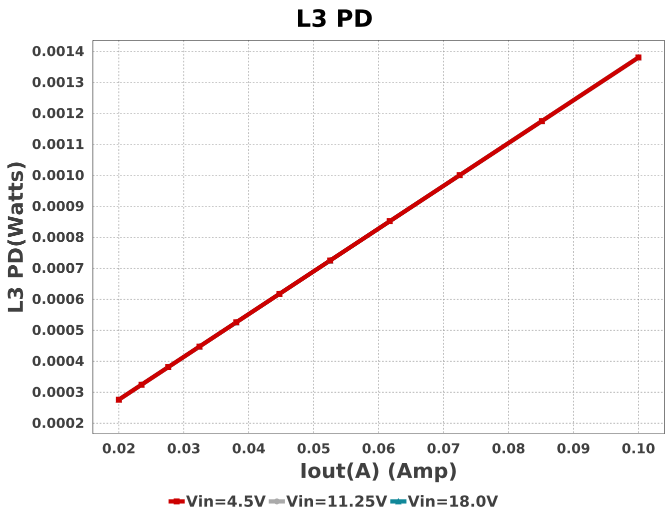
Loop Response Channel1

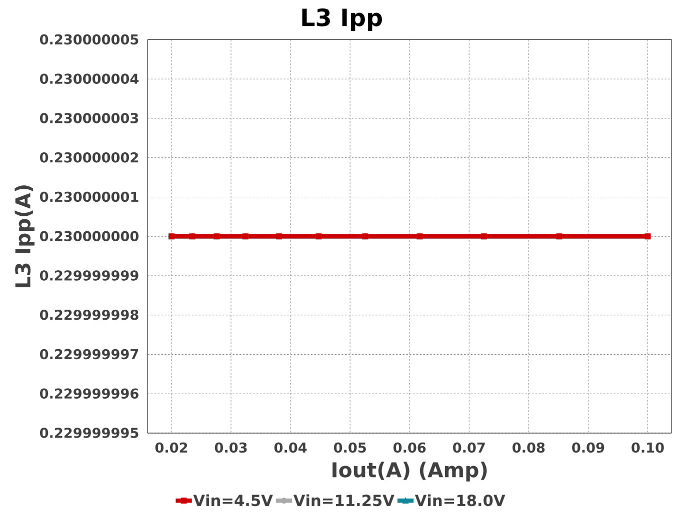


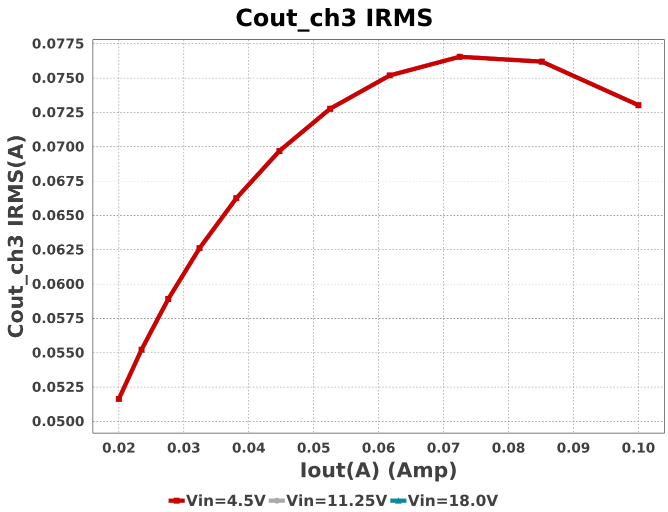
Loop Response Channel2

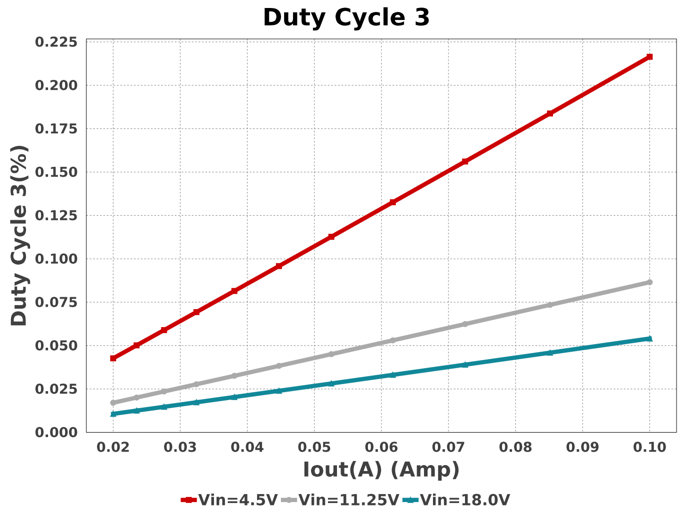


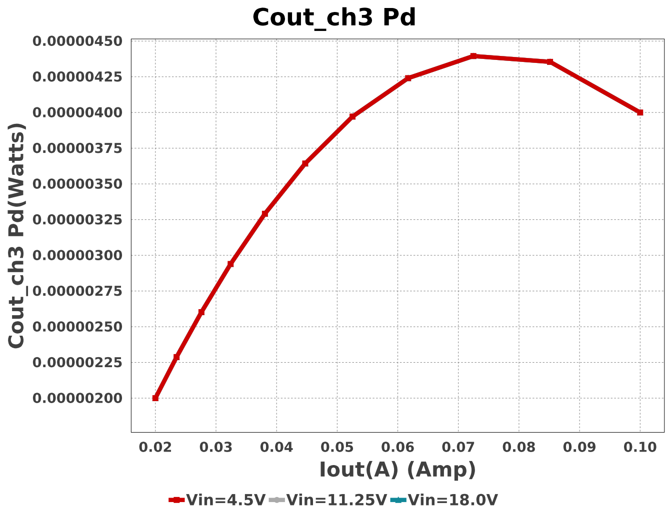

IC Tj
IC Tj(degC)
52.5 50.0 47.5 45.0 42.5 40.0 37.5 35.0 32.5 30.0
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

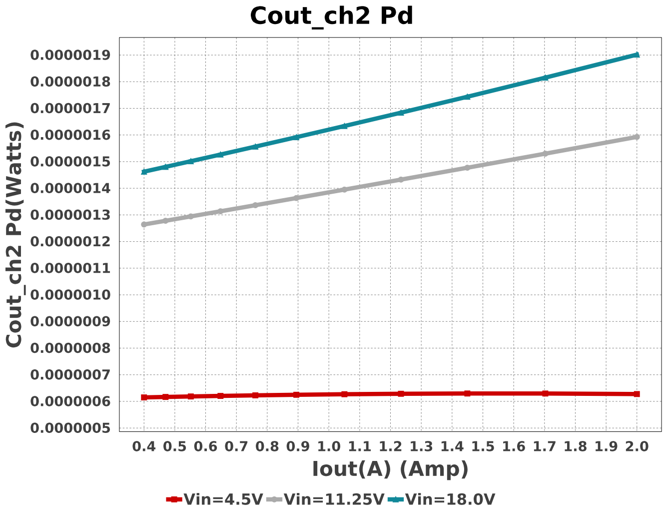

L3 PD
L3 PD(Watts)
0.0014 0.0013 0.0012 0.0011 0.0010 0.0009 0.0008 0.0007 0.0006 0.0005 0.0004 0.0003 0.0002
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

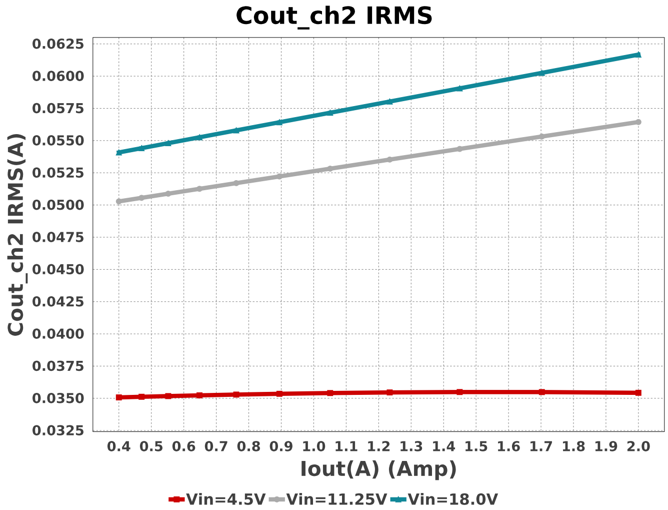

L3 Ipp
L3 Ipp(A)
0.230000005 0.230000004 0.230000003 0.230000002 0.230000001 0.230000000 0.229999999 0.229999998 0.229999997 0.229999996 0.229999995
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

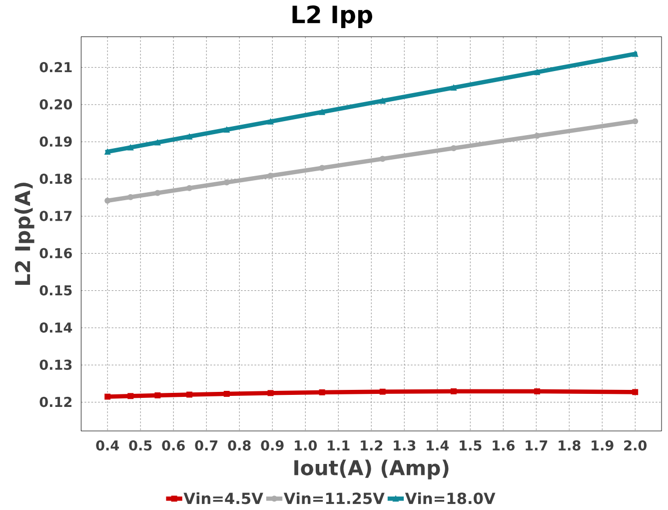

Cout_ch3 IRMS
Cout_ch3 IRMS(A)
0.0775 0.0750 0.0725 0.0700 0.0675 0.0650 0.0625 0.0600 0.0575 0.0550 0.0525 0.0500
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

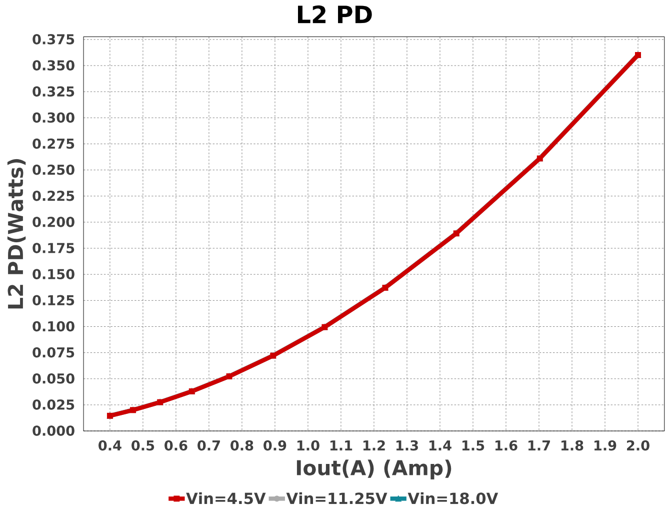

Duty Cycle 3
Duty Cycle 3(%)
0.225 0.200 0.175 0.150 0.125 0.100 0.075 0.050 0.025 0.000
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

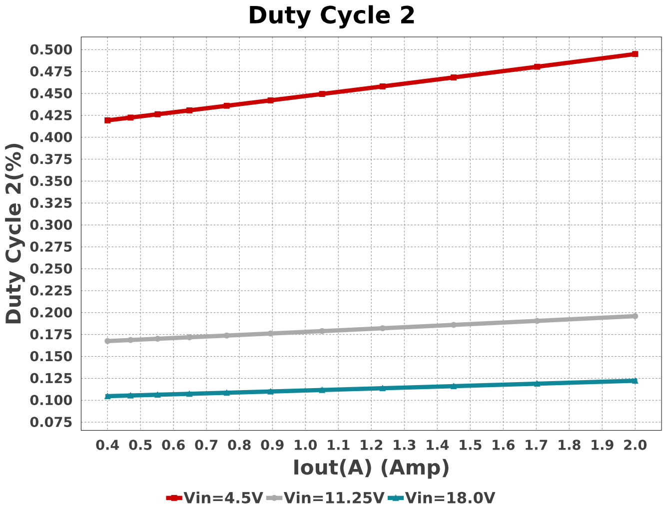

Cout_ch3 Pd
Cout_ch3 Pd(Watts)
0.00000450 0.00000425 0.00000400 0.00000375 0.00000350 0.00000325 0.00000300 0.00000275 0.00000250 0.00000225 0.00000200
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

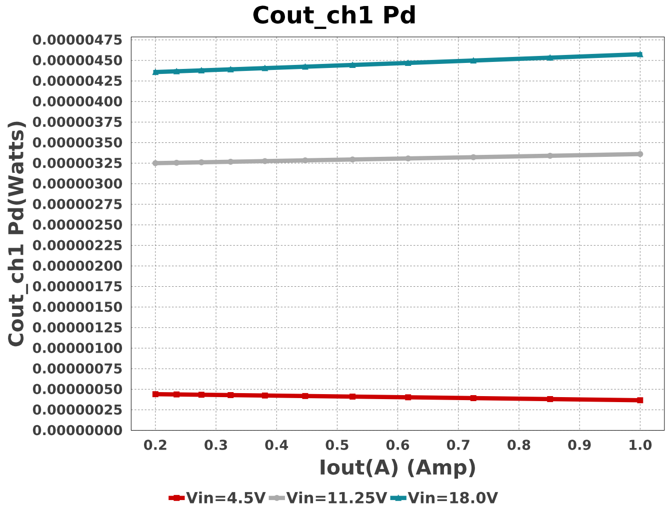

Cout_ch2 Pd
Cout_ch2 Pd(Watts)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

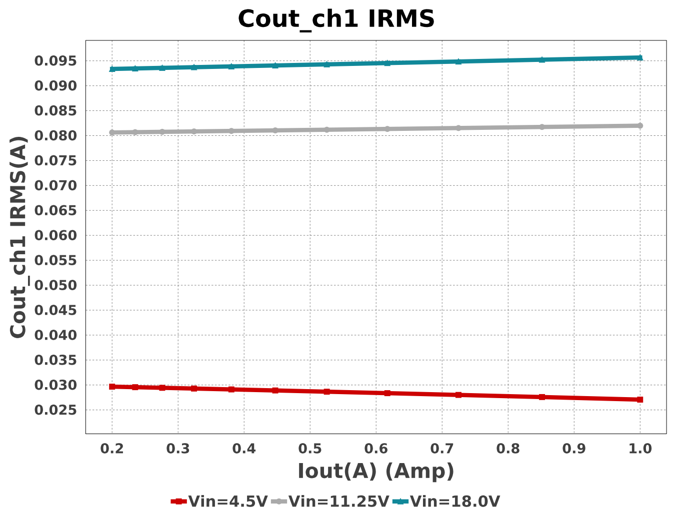

Cout_ch2 IRMS
Cout_ch2 IRMS(A)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

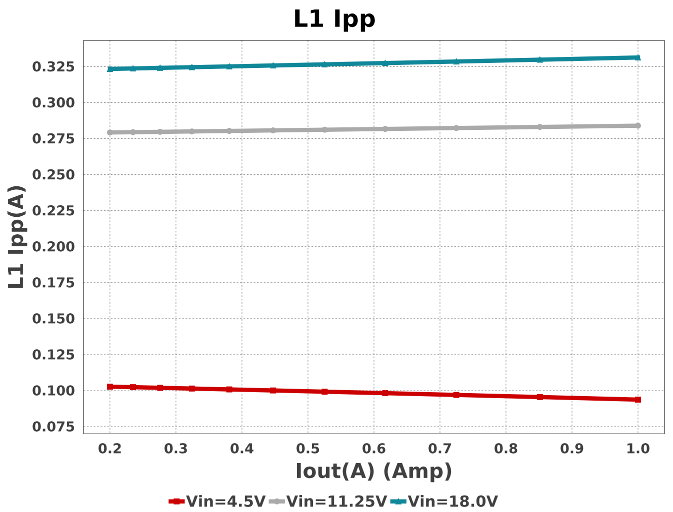

L2 Ipp
L2 Ipp(A)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

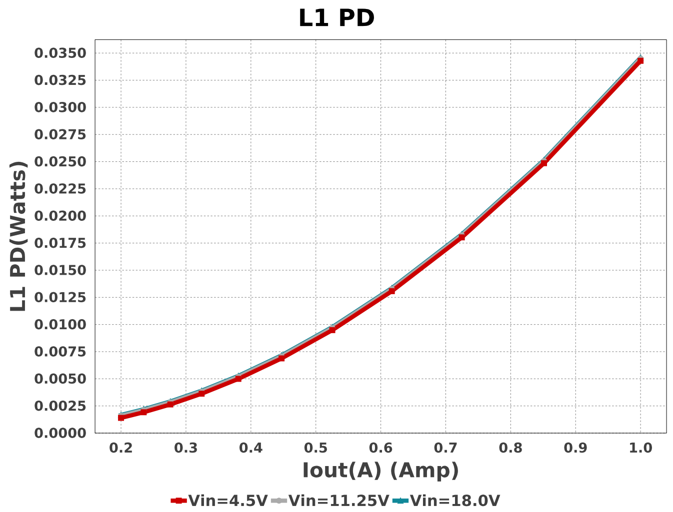

L2 PD
L2 PD(Watts)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V

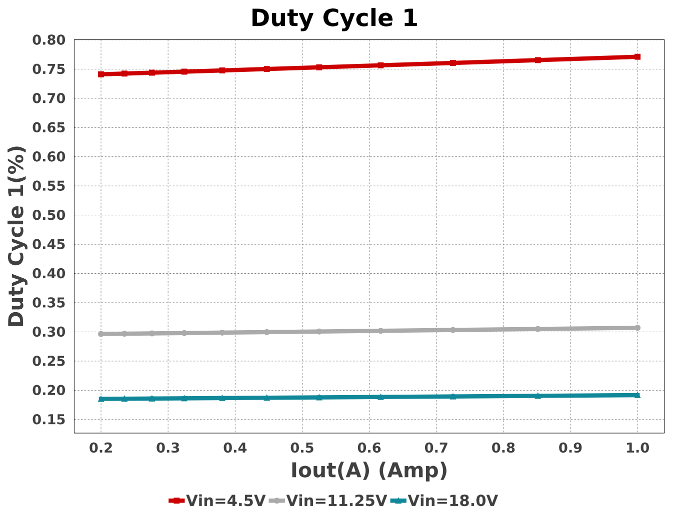

Duty Cycle 2
Duty Cycle 2(%)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V


Cout_ch1 Pd
Cout_ch1 Pd(Watts)
Iout(A) (Amp)
Vin=4.5V Vin=11.25V Vin=18.0V









Operating Values

#	Name	Value	Category	Description
1.	Cout_ch1 IRMS	95.591 mA	Capacitor	Output Channel 1 Capacitor RMS ripple current
2.	Cout_ch2 IRMS	53.376 mA	Capacitor	Output Channel 2 Capacitor RMS ripple current
3.	Cout_ch3 IRMS	73.03 mA	Capacitor	Output Channel 3 Capacitor RMS ripple current
4.	IC Pd	461.13 mW	IC	IC power dissipation
5.	IC Tj	38.3 degC	IC	IC junction temperature
6.	IC Tolerance	5.0 mV	IC	IC Feedback Tolerance
7.	ICThetaJA Effective	18.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
8.	Iin Avg	236.78 mA	IC	Average input current
9.	L1 Ipp	331.138 mA	Inductor	Peak-to-peak inductor ripple current
10.	L2Ipp	184.899 mA	Inductor	Channel 2 Inductor Peak to peak Current
11.	L3 Ipp	230.0 mA	Inductor	Inductor 3 peak to peak current
12.	Cross Freq Ch1	62.794 kHz	Loop	Bode plot crossover frequency
13.	Cross Freq Ch2	59.773 kHz	Loop	Bode plot crossover frequency
14.	Gain Marg Ch1	-15.008 dB	Loop	Bode Plot Gain Margin
15.	Gain Marg Ch2	-19.657 dB	Loop	Bode Plot Gain Margin
16.	Low Freq Gain Ch1	86.988 dB	Loop	Gain at 1Hz
17.	Low Freq Gain Ch2	95.248 dB	Loop	Gain at 1Hz
18.	Phase Marg Ch1	55.724 deg	Loop	Bode Plot Phase Margin
19.	Phase Marg Ch2	56.74 deg	Loop	Bode Plot Phase Margin
20.	Cout_ch1 Pd	4.569 µ	Power	Ouput channel 1 capacitor power dissipation
21.	Cout_ch2 Pd	1.424 µ	Power	Ouput channel 2 capacitor power dissipation
22.	Cout_ch3 Pd	4.0 µ	Power	Ouput channel 3 capacitor power dissipation
23.	IC Pd	461.13 mW	Power	IC power dissipation
24.	L1 Pd	34.573 m	Power	Inductor1 power loss
25.	L2 Pd	5.881 m	Power	Inductor2 power loss
26.	L3 Pd	1.38 m	Power	Inductor3 power loss
27.	Total Pd	402.123 mW	Power	Total Power Dissipation
28.	BOM Count	37	System Information	Total Design BOM count
29.	Duty Cycle 1	19.153 %	System Information	Duty cycle for Channel 1

#	Name	Value	Category	Description
30.	Duty Cycle 2	10.309 %	System Information	Duty cycle for Channel 2
31.	Duty Cycle 3	5.406 %	System Information	Duty cycle for Channel 2
32.	Efficiency	90.565 %	System Information	Steady state efficiency
33.	FootPrint	563.0 mm^2	System Information	Total Foot Print Area of BOM components
34.	Frequency	600.0 kHz	System Information	Switching frequency
35.	Frequency Ch2	600.0 kHz	System Information	Switching frequency
36.	Frequency Ch3	264.456 kHz	System Information	Switching frequency
37.	Iout1	1.0 A	System Information	Iout1 operating point
38.	Iout2	250.0 mA	System Information	Iout2 operating point
39.	Iout3	100.0 mA	System Information	Output Current channel 3
40.	Ch1 Mode	CCM	System Information	Channel 1 Conduction Mode
41.	Ch2 Mode	CCM	System Information	Channel 2 Conduction Mode
42.	Mode	PFM	System Information	Channel 3 Conduction Mode
43.	Pout1	3.3 W	System Information	Total output power
44.	Pout2	450.0 mW	System Information	Total output power
45.	Pout3	110.0 mW	System Information	Total output power
46.	Total BOM	$4.92	System Information	Total BOM Cost
47.	Vin	18.0 V	System Information	Vin operating point
48.	Vout Tolerance	2.502 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
49.	Vout1	3.3 V	System Information	Operational Voltage 1
50.	Vout1_Actual	3.318 V	System Information	Vout Actual calculated based on selected voltage divider resistors
51.	Vout2	1.8 V	System Information	Operational Voltage 2
52.	Vout2Tolerance	2.191 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout2_Actual	1.8 V	System Information	Vout Actual calculated based on selected voltage divider resistors
54.	Vout3	1.1 V	System Information	Operational Voltage 3
55.	Vout3Tolerance	1.754 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
56.	Vout3_Actual	1.095 V	System Information	Vout Actual calculated based on selected voltage divider resistors

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
Iout1	2.0	Output Current #1
Iout2	2.0	Output Current #2
VinMax	18.0	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	1.5	Output Voltage
Vout1	1.5	Output Voltage #1
Vout2	1.5	Output Voltage #2
base_pn	TPS65263	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

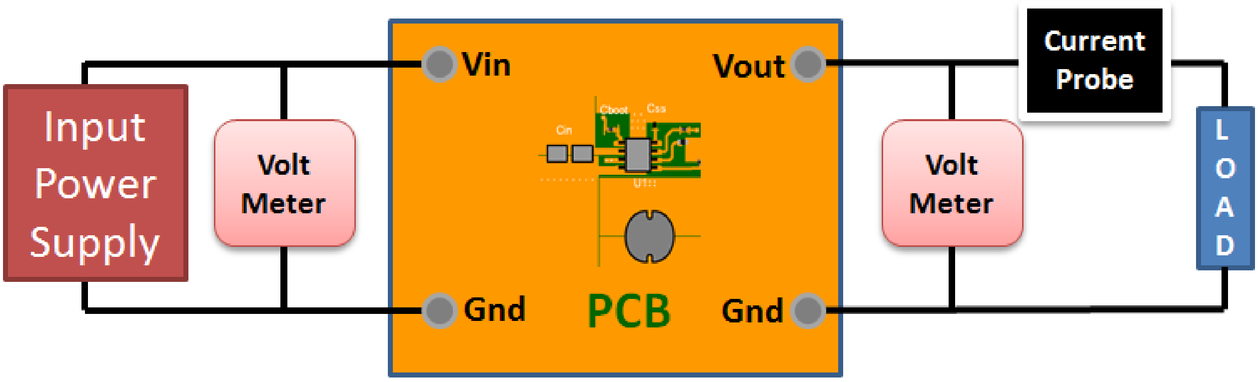
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 4.5V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Master key : 27AFC3A06A218B6F8EA41ED3B4C0DDB7[v1]

2. **TPS65263** Product Folder : http://www.ti.com/product/TPS65263 : contains the data sheet and other resources.